Dear Lisa, Jay, and Jack,

I've made the decision to backtrack on the model selection. In December we had worked out a model that used the actual pre-harvest shade values and estimated post-harvest shade values, both in estimation and in predicting effects. I believe we all think this model to be adequate, although there may be some error-accounting issues with it yet.

Any version of the one-shade models (that estimate shade pre & post-harvest, accomplished with random effects) perform the estimation portion of the modeling effort very well. In the table below are four different versions of the one-shade model. Models A and B are the same as I introduced in the document **Findings Summary.doc**; models C & D are different (in this case, they are identical, respectively, to A & B except in how they handle the simulations). The last time we communicated, we had agreed on pursuing Model D.

The problem is that every version produces simulation effects that are undesirable.

	Conditions	Model A	Model B	Model C	Model D
	Pre distance =	0	1/170	0	1/170
	Simulation pre-harvest value =	pre-harvest	pre-harvest	2-sided no-harvest	2-sided no-harvest
	Variables				
Temperature	CT	**0.80**	**0.80**	**0.78**	**0.79**
Temperature	SHest	**-4.84**	**-4.86**	**-4.82**	**-4.81**
Temperature	Grad	-0.05	-0.05	-0.05	-0.05
Shade	1-side	**0.32**	0.16	**0.32**	0.15
Shade	2-sided	-0.32	**-0.48**	-0.32	**-0.49**
Shade	Ht	**-0.28**	**-0.28**	**-0.28**	**-0.28**
Shade	HWD	-0.04	-0.04	-0.04	-0.04
Shade	BA	**0.25**	**0.25**	**0.25**	**0.25**
Shade	invMMD	**-0.24**	**-0.19**	**-0.24**	**-0.19**
	Model Prediction				
	As Harvested	P = 0.59 S = 0.01	P = 0.59 S = 0.01	P = 0.47 S = 0.11	P =0.37 S = 0.04
	State Forest	Mean = 0.48 C	Mean = 0.55 C	Mean = 0.3 C	Mean = 0.26 C
	Private Forest	Mean = 1.15	Mean = 1.14	Diminished mean (0.9 C)	Diminished mean (0.8 C)
	Distance	Crosses > 120'	Crosses > 120'	Crosses @ 100'	Crosses @ 75'

To explain more about this table, there are two conditions of interest. The condition "Pre distance" indicates that for the variable invMMD (or 1/Median Max Distance) the harvest edge is assumed to either be infinitely far away or equal to 1/170'. This condition affects parameter estimation and by extension simulation outcomes. The second condition, "Simulation pre-harvest value", affects how we conduct the simulations. We either compare a simulated harvest regime against "pre-harvest conditions" or against a two-sided harvest where no trees were removed. The only difference between these two is that the parameter value for 2-sided harvest indicator variable is set to either 0 (pre-harvest) or 1 (2-sided no-harvest). Model pair A & C shares the same parameter estimates, as do models B & D. The difference within each pair is in how the pre-harvest data are interpreted (Simulation pre-harvest value).

The two simulation options were used to explore the effects on variables and their associated beta values. In the table we have parameter estimates for temperature (which differ between models AC/BD but not at the hundredths place). Bold-faced parameter estimates indicate that the parameter credibility intervals do not include zero.

Model predictions:
As Harvested: This "simulation" takes the data that were used in the estimation and predicts stream temperature increases due to harvest for each site. This simulation differs from the others in that, for pre-harvest, a "simulated 2-sided no-harvest" is actually one-sided for sites that were only harvested on one side and two sided for all others.

State Forest: This simulates a harvest of all sites, starting with the pre-harvest stand data, according to the State Forest Northwest Forest Management Plan.

Private Forest: This simulates a harvest of all sites according to the FPA.

Distance: This simulation examines the effects of hard-edged clearcuts out to a variety of distances from the stream.

Patterns:
When examining the results from the simulations, I compare the results to those observed in previous iterations and from the Effects Analysis manuscript. The earlier work serves as a yardstick by which to judge the current predicted results as reasonable or not.

As Harvested
For the As Harvested predictions, things are generally OK-ish for models A & B. That is, private forest response visually looks pretty good, and state forest sites look somewhat odd but OK. For model A, the estimated temperature increase on average for private sites is 0.62 C, while for State sites it is 0.12 C. Things seem better (i.e., State Forest closer to zero, as in earlier renditions of modeling efforts) for Model B. In that case the private increase is 0.59 C, similar to before, while State sites average +0.005 C. Model B site estimates are presented below in Figure 1.

Things are still somewhat strange for state forest sites. Note that in Figure 1 virtually all of these sites are negative. The mean for these sites is pulled up by the two state forest sites that are 2-sided. I am concerned about the colinearity between the number of sides harvested and the variable invMMD (correlation coefficient = 0.51). The correlation between the number of sides & ownership is 0.64.

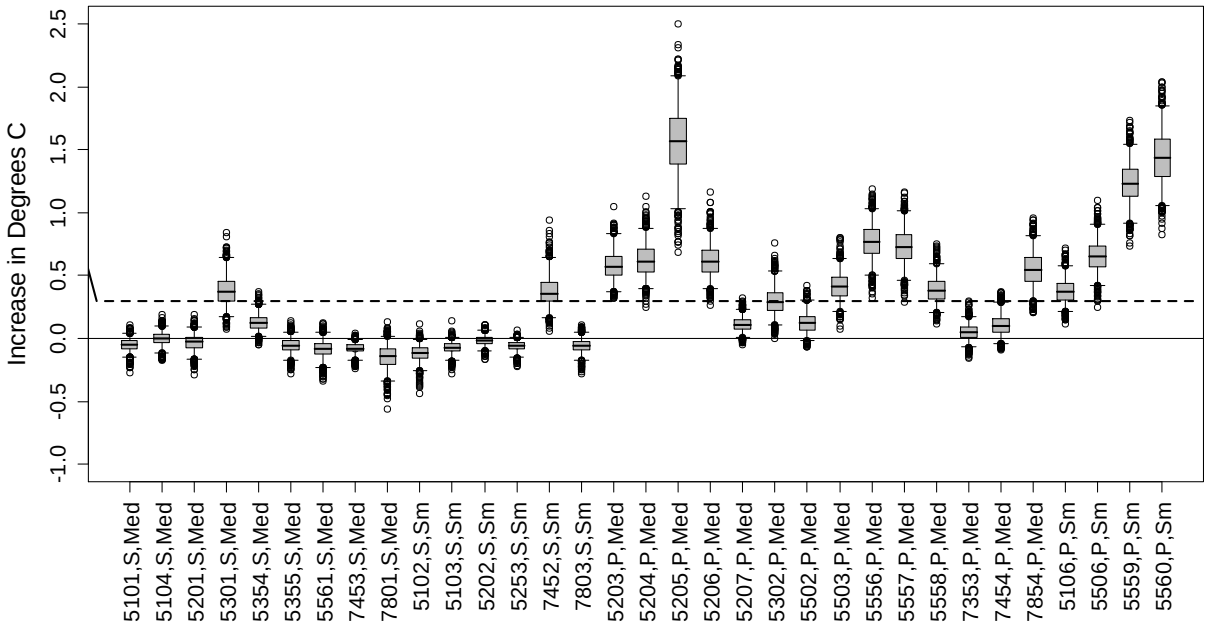

Figure 1. Individual estimated temperature changes for the No Harvest simulation, Model B.

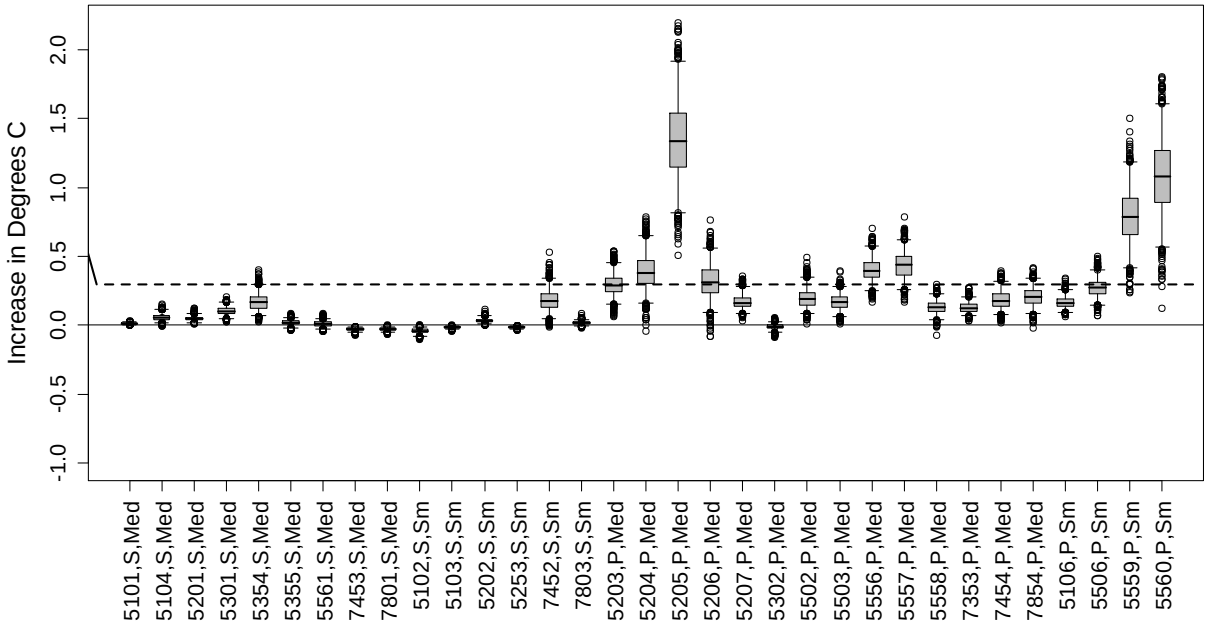

Figure 2. Individual estimated temperature changes for the No Harvest simulation, Model D.

For models C & D, the state forest estimates hovered around zero with a muted effect for 2-sided harvests (figure 2). The effect for private forests was muted as well, dropping the mean estimated temperature increase from ~0.6 to 0.37 C. This makes sense, as simulated values from Model D disregard the harvest signal captured by the 2-sided harvest indicator variable.

The consequence of simulating pre-harvest conditions as a 1- and 2-sided harvest with no tree removal appears to be a diminished harvest effect. The consequence for setting the Pre distance to 0 or 1/170 is to diminish the contribution of invMMD to the overall shade value and change the influence of the 1-sided and 2-sided parameter estimates. The 1- and 2-sided parameter values appear to convey information regarding harvest effect; therefore, the harvest effect appears to be best conveyed when Simulation pre-harvest value = pre-harvest.

State Forest

The state forest simulation is examining a light-touch harvest scenario. For this simulation, models A and B produce results that I have a hard time accepting. Essentially, for sites with little entry (and some with no entry) within 100', stream temperatures are expected to rise by around 0.5 C. This increase is reduced to 0.3 C or lower when the effects of the indicator variable for 2-sided harvests is removed in models C & D.

Private Forest

Private forest simulation temperature estimate responses were similar between models A & B, which echoes results from the As Harvested simulations. As stated before, the 2-sided parameter estimate likely conveys information regarding harvest effect; treating the pre-harvest as a 2-sided no-harvest condition as was done in models C & D results in lower predicted harvest effects.

Distance

The distance simulations enact timber harvest at set distances from the stream: 10' intervals from 20' to 120', measured as a slope distance. The mean response of all sites to a simulated harvest is presented in Figure 3. In general, the decreasing influence of buffer width on stream temperature is evident in all four plots. However, we are particularly interested in value of 0.3 C. Only when the simulation is modeled pre-harvest as "2-sided no-harvest" does the curve dip below 0.3, instead of approaching some sort of asymptote above it. Model C crossed 0.3 C around 100', and Model D crossed at 75'. Their curves were shallow, so the 95% Credibility Intervals included a fairly broad distribution of distances.

I have a hard time believing buffers are required beyond 120' to achieve <0.3 C increase in stream temperatures; therefore, I have my doubts that models A & B succeed in reflecting stream temperature response to low-harvest conditions. However, as we saw for private forest simulations, removing the effect of the 2-sided indicator variable reduces the predicted temperature increase. Therefore, I'm not sure I hold much faith in models C & D representing reality either.

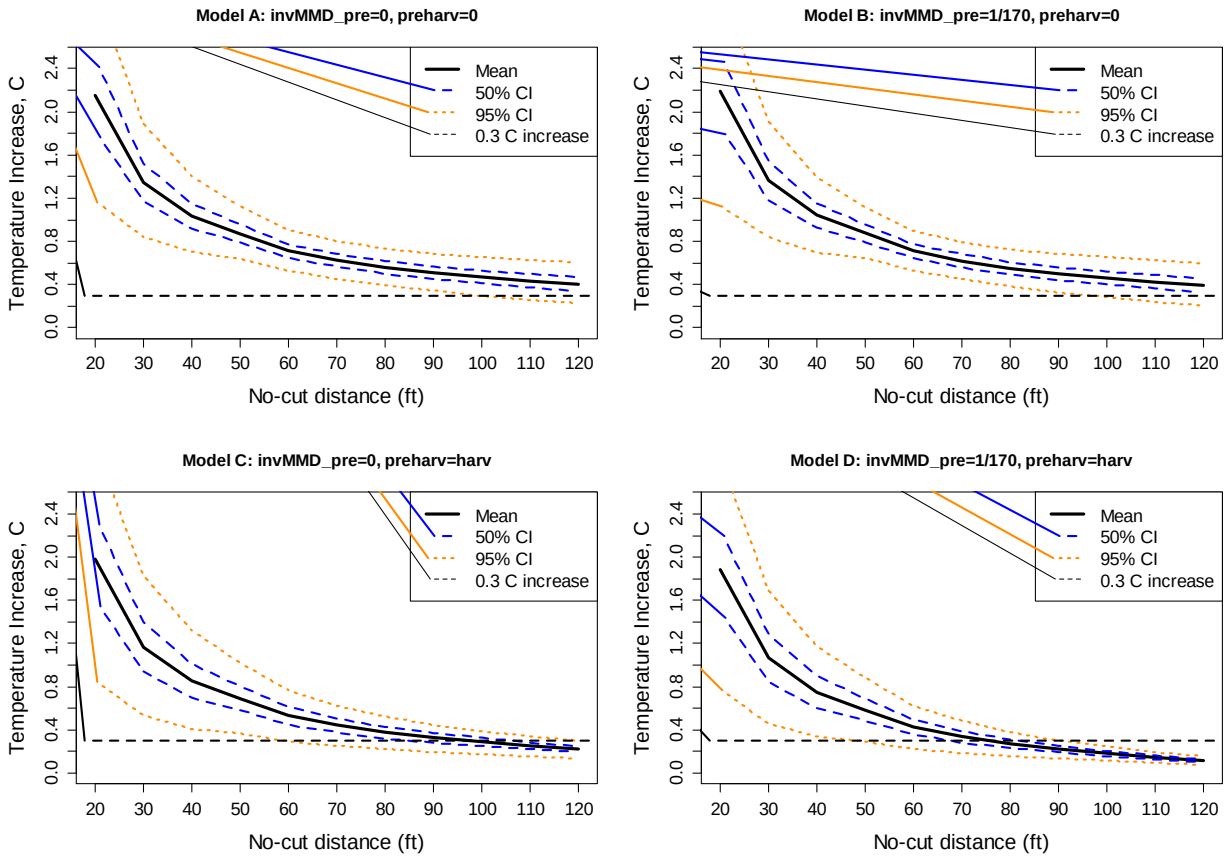

Figure 3. Temperature increases due to harvest at different slope distances from the stream, under the four model conditions.

Conclusion: The formulation of these models has introduced some troublesome behaviors for simulations. Models A & B provide the most reasonable estimates of the As-harvested and Private Forest scenarios, but exhibit some questionable behaviors under low-harvest scenarios (State Forest & Distance simulations). Models C & D are the inverse in behavior – it appears (and seems reasonable) that reinterpreting a pre-harvest condition as a 2-sided harvest with no tree actually harvested removes some of the harvest effect from the picture, dampening the predicted temperature increases for the Private Forest harvest and dropping the asymptotes of the curves for the Distance simulation below 0.3 C. I think we'll be better served by returning to the earlier model.